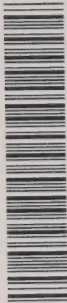


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THE USE OF AIRCRAFT

IN

CANADIAN AGRICULTURE

1957

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THE USE OF AIRCRAFT IN CANADIAN AGRICULTURE in 1957

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THE USE OF AIRCRAFT IN CANADIAN AGRICULTURE in 1957

Since its first aircraft flight, at Baddeck, Nova Scotia, in February 1909, the first trans-Canada flight (Halifax to Vancouver) in October 1920, and the first flight for agricultural purposes at Lake Timiskaming, Ontario, in September 1920, Canada has made great strides in the use of the aircraft for transporting people and freight, surveying, patrolling, prospecting and flying for pleasure.^{1/} During the 1930's and World War II agricultural flying, especially aerial spraying and dusting, did not keep in step with the general progress of aviation.

During World War II thousands of farmers became airmen and after the war most of them returned to rural areas. Their training, interest in flying and progressive thinking about the part an aircraft could play in farming or ranching gave impetus to postwar activity in the use of the aircraft in agriculture. Many war surplus aircraft and parts were then available at moderate costs. Continuous improvements to the chemicals and the mechanisms for distributing the chemicals also played an important role.

In 1952 the Agriculture Division of the Dominion Bureau of Statistics made a study of agricultural spraying and found that 221,500 acres were covered by the use of aircraft.

However, one of the greatest "shots in the aerial agricultural arm" was made in the early part of 1957 when the Department of Transport gave greater scope to the farmers who owned private aircraft. Previous to 1957 a farmer, unless he had a commercial license, could work only over his own farm -- now he could work over his neighbors' farms for hire, to a certain extent. The regulation extracted from Part VII of the Air Regulations dealing with Commercial and Service Operators, reads:

"(2) A person whose chief source of income is from farming is exempted from the provision of this Part, if

- (a) he owns an aircraft having a disposable load not exceeding 1,100 pounds,
- (b) he engages in aerial spraying or dusting for hire and reward within an area having a radius of twenty-five miles from the center of his farm, and

^{1/} The Department of Agriculture designed the first dust hopper for aerial use in 1924 and the first dusting for the control of grain rust was done in 1925 in the vicinities of The Pas, Norway House and High River. All agricultural aerial spraying before World War II was carried out by military aircraft.

- (c) he complies with such conditions and limitations as may be directed by the Minister".

Nature of the study

We know that the aircraft is rendering useful services to the agricultural industry; but the need for more precise information on the areas served and the extent of these services is required. With this in mind, the Aerial Surveys Unit, a research unit attached to the Economics Division of the Canada Department of Agriculture and doing work for the Prairie Farm Rehabilitation Administration, made a survey, in 1957, of the use of the aircraft for agricultural purposes in Canada.

A questionnaire was sent to 44 commercial owners presumably engaged in aerial spraying. Of this number, 37 sent replies, including three replies from commercial owners who did no agricultural spraying in 1957. We assumed that the others did not do any agricultural spraying.

In the belief that other commercial owners were planning to do agricultural spraying work in the near future 99 other questionnaires were sent to aircraft owners located in or near extensive farming areas. Of the 51 who replied three were planning to start spraying in 1958 and three more said that they were planning to do so in the near future.

Two Questionnaires were also sent to 124 private owners, including members of the Flying Farmers Association and other private owners whose aircraft were presumably used for spraying purposes. Eighty-six of these 124 aircraft owners returned filled-in questionnaires.

The replies showed definitely that aerial activity in agriculture was not confined solely to spraying and dusting. Consequently, we expanded the study and sent additional questionnaires to 332 private owners who lived in rural areas or in small villages located in or near extensive farming areas. Of these 332 owners 149 returned filled-in questionnaires.

The one-page questionnaire was divided into four main parts, namely:

(a) spraying, dusting, fertilizing and seeding

weed and insect control
acres covered
hours of flying
personnel - air and ground
months of employment
rates charged per acre

(b) land supervision

types of supervision
acres covered
hours of flying

(c) transportation

types of farm transportation
hours of flying

(d) recreation

remarks
hours of flying

COMMERCIAL AGRICULTURAL SPRAYING

Agricultural aircraft can be divided into three main operational groups:

- (a) commercially operated aircraft used solely for agricultural spraying or dusting and other agricultural purposes;
- (b) privately operated aircraft used solely for agricultural spraying or dusting and other agricultural purposes;
- (c) privately operated aircraft used for combined agricultural and recreational purposes.

In 1957, 80 commercially operated agricultural spraying aircraft or 4.7 per cent of the total of commercially operated aircraft in Canada, flew 5,304 hours for agricultural purposes. Twenty-nine privately operated agricultural spraying aircraft, or 1.6 per cent of the total privately operated aircraft in Canada, flew 1,797 hours for agricultural purposes. In the combined agricultural and recreational group, 91 privately operated aircraft flew 8,354 hours for agricultural purposes, greatly exceeding the time spent in recreational flying.

The commercially operated aircraft consisted of the following types: Tiger Moth, Luscombe, Aeronca, Beaver, Stearman, Cessna 140A, Piper PA-11, Piper PA-12, Piper PA-18, Piper J3 and Piper J3C.

The privately operated aircraft used for agricultural purposes, including combined agricultural and recreational activities, consisted of the following types: Tiger Moth, Luscombe, Aeronca Champ, Aeronca Chief, Aeronca Super Chief, Stinson 108, Stinson HW75, Cessna 120, Cessna 170, Cessna 170A, Cessna 170B, Piper PA-11, Piper PA-12, Piper PA-20, Piper PA-22, Piper PA-18, Piper J3, Piper J3C, Mooney, Bellanca, Fleet, Riley Twinn Navion, Funk, Call Air Cadet and Taylorcraft.

Most of the operators used the boom type equipment for spraying. This consists simply of a boom located underneath and parallel to the mainplane of the aircraft. Spaced at intervals along the boom are numerous nozzles. A small wind-driven propeller attached to a pump connected to the boom provides the power for the pressure in the system.

In 1957, 34 commercial owners or companies did spraying and dusting work for agriculture (Table 1). Three of these companies did spraying for the control of flies and mosquitoes; this type of work is not directly concerned with agricultural practices but is of interest to ranchers and others whose cattle and other livestock are plagued by flies and mosquitoes.

Table 1.— Number of aircraft owners, aircraft and hours flown in commercial and private agricultural spraying and dusting and other private agricultural flying in Canada, in 1957

Province	Commercial agricultural spraying and dusting		Private agricultural spraying and dusting		Other private agricultural flying	
	Owners	Aircraft	Hours	Owners	Aircraft	Hours
B.C.	1 <u>b</u> /	5	220	0	0	550
Alta.	5 <u>c</u> /	6	441	6 <u>a</u> /	335	2,385
Sask.	19 <u>d</u> /	36	2,288	20 <u>h</u> /	1,452	2,497
Man.	3 <u>e</u> /	5	417	1 <u>i</u> /	10	2,436
Ont.	5 <u>f</u> /	25	1,896	0	0	272
Que. a/	1	3	42	0	0	214
Total	34	80	5,304	27	1,797	8,354

a/ Work actually carried out in New Brunswick.

b/ Include 15 owners who also flew 402 hours on agricultural work other than spraying.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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" " " " " " " " " " "

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10

f/ In addition, one commercial operator used three aircraft for some agricultural work other than spraying.

g/ Include 19 owners who also flew 341 hours on agricultural work other than spraying.

10
9
8
7
6
5
4
3
2
1

[illegible]

11/ k/ Include 16 owners who were intending to spray in 1958.

[illegible]

11

Of the 34 commercial owners, one used ten aircraft for agricultural purposes, four owners used four each, four used three each, seven used two each and the others used on each.

Of the 34 owners, one started agricultural spraying in 1946, one in 1947, one in 1948, six in 1949, eight in 1950, one in 1951, five in 1952, four in 1953, one in 1954, two in 1955, one in 1956 (three did not supply the required information).

The activities of these commercial owners or companies, across Canada, are described below:

New Brunswick

Brush Control -- 3,300 acres were sprayed (No cost data).

Ontario

Weed Control -- 60 acres of wheat were sprayed (No cost data).
Insect Control -- 22,300 acres of tobacco were sprayed and dusted for the control of hornworm, using Endrin in liquid and dust form.

500 acres of tobacco were dusted for the control of suckers using Maleic Hydrazide. (Average cost of application over the tobacco areas \$4.25 per acre).

1,000 acres of peas were sprayed for the control of aphids, using Malathion.

300 acres of tomatoes were dusted for blight control. Many Christmas tree plantations in southern Ontario were dusted for control of sawfly.

4,000 acres of spruce trees in southern Ontario, mostly in Brant and Elgin Counties, were sprayed (associated with agricultural areas).

Fertilizing -- 1,050 acres of tobacco, using 10%N - 20% P₂O₅ - 10% K₂O liquid foliar spray, were covered at the rate of 1.5 gallons per acre.

Other actitives -- 2,200 acres of brush were cleared using 2,4-D and 2, 4-5-T. Thousands of acres were sprayed for control of flies and mosquitoes in the vicinities of Toronto, Hamilton, Lake St. Clair and Lake Erie areas, Rondeau Park, Lake Simcoe and Muskoka areas, using DDT in fuel oil applied at the rate of two to three quarts per acre.

Manitoba

Weed Control -- 27,459 acres of wheat, flax, oats, barley and rye were sprayed with 2,4-D. (Average cost of application \$1.10 per acre).

Some spraying was done for the control of wild millet in sugar beets and the control of broad-leaved weeds in potatoes.

Insect Control -- 100 acres of potatoes were sprayed for the control of the potato beetle.

Saskatchewan

Weed Control -- 188,490 acres of wheat, flax, oats and barley were sprayed for the control of stockweed, mustard and thistle, using 2,4-D in fuel oil or water and applied at the average rate of two quarts per acre. (Average cost of application \$1.00 per acre).

Insect Control -- 3,400 acres were sprayed for the control of grasshoppers. (Average cost of application \$1.25 per acre).

Fertilizing -- Some fertilizing was carried out but the acreages and costs were not recorded by the operators.

Buck Brush Control -- 4,500 acres were dusted (No cost data).

Alberta

Weed Control -- 35,882 acres of wheat, flax and oats were sprayed with 2, 4-D applied at the rate of two quarts per acre. (Average cost of application \$1.10).

Insect Control -- 2,061 acres were sprayed for the control of grasshoppers. (Average cost of application varied from \$1.15 per acre in one part of the province to \$2.90 per acre in another).

British Columbia

Weed Control -- 6,000 acres of grains were sprayed. (No cost data).

Insect Control -- 14,000 acres, other than forest, were sprayed. (No cost data).

Other commercial agricultural work

Thirteen companies did other agricultural work besides spraying and dusting. Their aircraft flew a total of 202 hours, for purposes such as the following, listed according to the number of replies:

- (a) locating flooded areas;
- (b) checking drainage and irrigation systems;
- (c) supervision and transportation on ranches;
- (d) checking stockwater dams;
- (e) looking for stray cattle;
- (f) checking tobacco areas;
- (g) transporting farmers when the roads are blocked;
- (h) inspection of crops;
- (j) cruising for game and control of predators;
- (k) checking the roofs of barns and other buildings.

Personnel

In Eastern Canada 29 pilots and 33 ground personnel worked five weeks on the average during the plant growing period. In Western Canada 51 pilots and 101 ground personnel worked 4.7 weeks on the average during the plant growing period.

Revenue to commercial owners

In Manitoba, Saskatchewan, Alberta and British Columbia the total revenue from agricultural spraying was \$285,460. The average revenue per acre was just over one dollar. The farmer supplied the chemicals for spraying.

In Ontario and New Brunswick the total revenue was \$141,531 and the average revenue per acre was about five dollars. This higher revenue per acre is understandable when one considers the risks of aerial spraying or dusting in more congested areas with a variety of crops many of which may be damaged by the chemicals being sprayed.

Remarks by commercial operators

(a) Informal enquiries were made from several of the commercial spraying companies on what was expected of a pilot doing agricultural spraying work. They all agreed on two points. First, the pilot must have plenty of recent light plane flying time. This is understandable especially when pilots who become used to operating high powered aircraft depend very much on the power instead of the aerodynamics of manoeuvrability that is so necessary when operating low powered light planes. Second, the pilot should be young as flying over small fields calls for 'split second timing' and a great knowledge of the mechanical reflex of the aircraft, as well as the maintenance of physical strength of this 'split timing' over a long, continuous period of time.

(b) In the United States there is continuous work for the commercial spraying company or operator but in Canada the investment may be too

high when such investment is immobile for many months of the year. An aircraft has to be structurally altered to be equipped for spraying or dusting purposes. To make an alteration at the end of the spraying season, so that the aircraft can be used for other purposes, is a costly and time-consuming procedure.

PRIVATE AGRICULTURAL SPRAYING

Twenty-seven private owners used 29 aircraft for agricultural spraying in Manitoba, Saskatchewan, and Alberta in 1957. Three of the owners used two aircraft each and the remainder used on each. Two started spraying in 1947, one in 1948, two in 1950, two in 1951, one in 1952 and the others from 1953 to 1957. No private owners did agricultural spraying in Eastern Canada.

The vast crop areas of Western Canada are ideal for efficient spraying by aircraft. There is little danger of chemcially damaging a neighbor's special crop. Large sections of the land forms are lacustrine, deltaic and non-rugged moraines which give the pilots more scope for turns and flying heights above the crops while keeping watch for man-made obstructions such as telephone and hydro wires, stacks, buildings and windmills. The western areas also have more local landing strips.

Farms are generally smaller in Eastern than in Western Canada and also have a wider variety of crops. The area of operations is thus more congested and the pilot must do very precise work to avoid the drifting of chemicals on adjacent crops. Moreover, some farmers cannot build local landing strips. The result is a set of conditions which dampens interest in the direct use of aircraft in agriculture.

The agricultural spraying activities of the private owners are described below:

Manitoba

Weed Control -- 1,000 acres of grain were sprayed. (No cost data).

Saskatchewan

Weed Control -- 93,971 acres of wheat, flax, oats, barley and mixed grains were sprayed with 2,4-D applied at the average rate of two quarts per acre. (Average cost of application \$1.00 per acre).

Insect Control -- 3,700 acres were sprayed for the control of grasshoppers using chlordane and aldrin in fuel oil applied at the average rate of two quarts per acre. (No cost data).

Alberta

Weed Control -- 23,600 acres of grain were sprayed. (Average cost of application \$1.00 per acre).

Personnel

In Western Canada (Alberta, Saskatchewan and Manitoba) 29 pilots and 44 ground personnel worked 3.9 weeks, on the average, during the plant growing period. When the pilot or flying farmer said that he had his farming neighbor as ground personnel, the 'ground personnel' was counted as 'one' because the neighbor worked only a fraction of the time until the pilot or flying farmer moved to the next farm.

Revenue to private owners

The revenue from 85,121 acres covered by the private owners was \$88,386 or about \$1.00 per acre. The remaining 34,150 acres were sprayed by private owners without remuneration.

Remarks by private operators

(a) All operators agreed that, over wide areas, the aircraft is the most efficient tool for spraying a variety of crops. However, over smaller or more congested areas the high costs of an aircraft do not warrant its purchase unless the farmer has spraying equipment and can spray for hire over the legal 25-mile radius, centered from his own farm, to defray the original investment.

(b) The private spraying pilot is conscious of his safety at any age. He knows his immediate territory very well both with regard to obstructions and local climatic conditions. He also has more time to complete manoeuvres and cover the area to be sprayed than the commercial operator who must be continually busy.

OTHER PRIVATE AGRICULTURAL FLYING

Eighty-four owners used 91 aircraft for combined agricultural (land supervision, farm transportation) and recreational purposes other than spraying. They flew a total of 8,354 agricultural hours. In addition, 19 of the privately owned aircraft that participated in spraying were flown for 341 hours for agricultural purposes other than spraying or dusting.

The following is a list, by provinces, of the number of aircraft owners who used their aircraft for agricultural and recreational purposes other than spraying or dusting:

British Columbia - 3

Alberta - 22, including two who intend to spray in 1958 and one for rural missionary work.

- Saskatchewan - 28, including eight who intend to spray in 1958.
- Manitoba - 22, including eight who intend to spray in 1958, one doctor who farmed besides transporting rural patients, two for rural missionary work, and two used by grain companies.
- Ontario - seven, including one for rural missionary work.
- Quebec - two, including one for rural missionary work.
- Others - 19 of the aircraft that were used for private agricultural spraying also carried out other agricultural flying.

Land supervision

The following activities were carried out in association with land supervision and are listed according to the number of replies from private owners:

- (a) finding strayed or injured cattle and cattle that are calving, counting cattle, rounding up cattle, checking cattle on isolated parcels of land, checking and repairing fences, windmills and other water facilities, checking for leaks and breaks in granaries especially in winter when the roads are blocked, dropping salt blocks, checking sheep and other livestock;^{1/}
- (b) checking watersheds, run-off conditions, flooded areas and drainage and irrigation systems;
- (c) checking weed and crop growth, crop damage, pasture conditions, orientation of field layout, and general field conditions including the time for seeding or summerfallowing;
- (d) flying low over flax, vineyards and other special crops to raise the dawn temperatures so that the frost will not damage the crops;
- (e) chasing ducks and other fowl from swathed grain;
- (f) timber cruising by farmers who have timber areas adjacent to or distant from their farmsteads;
- (g) hunting coyotes, foxes and other predatory game including hunting over turkey and chicken ranches;
- (h) surveying farm land before purchasing;

^{1/} A few veterinarians use aircraft to locate and aid injured livestock, and as one of their "chief sources of communications" in winter when roads are blocked.

- (j) watching for fires over the prairie and tree farms;
- (k) taking photographs over the individual farm during the spring to have as a permanent record when dealing with future drainage work or vegetative growth.

Farm transportation

Many of the operators said that the uses of the aircraft for transportation are too numerous to mention both in summer when time is limited and in winter when the roads are closed.^{1/} They also said that the aircraft took the place of a car or small truck.

The following activities were carried out along with farm transportation and are listed according to the number of replies:

- (a) getting repair parts for their own or their neighbors' farm implements or other farm and household necessities in a hurry or when the roads are closed;
- (b) transporting workers to parts of the immediate or distant isolated areas of the farms -- even, at times, flying meals to the workers;
- (c) flying repair parts to road construction and road repairing equipment (equipment owned by the farmer), and flying the operators of the equipment to and from the scene, especially during the winter;
- (d) flying to farm organization meetings, also taking along neighbors who previously did not find time to attend;
- (e) transporting slaughtered cattle from remote areas to market.

A few salesmen and servicemen of farm machinery used aircraft in their businesses and felt that they gave the farmer a more efficient service, saving time and getting an over-all or aerial view of the farmer's land and buildings.

A few grain companies used aircraft for transportation in the supervision of their grain elevators -- indirectly serving the farmers by efficiently keeping their organizations continuously up to par.

Recreational and social

Most of the aircraft owners were interested in hunting and fishing, local visiting, taking their neighbors on sightseeing trips, trips to agricultural exhibitions and fairs and many different types of agricultural meetings and conventions in Canada and elsewhere.

Four of the clergymen or missionaries used aircraft to quickly cover their rural parishes and circuits.

^{1/} In winter the aircraft are fitted with skis.

THE HELICOPTER IN AGRICULTURE

In 1955 the Soil Survey Section of the Research Council of Alberta, in co-operation with the Alberta Department of Lands and Forests, used a helicopter to traverse 16,000 square miles. The same area was covered by pack-horse outfits in 1952 and 1953. The purpose of the soil survey was to complete, as soon as possible, an inventory of the soil resources in the unsettled parts of Alberta. The information obtained was sufficient to permit mapping of pasture and woodland areas as well as doubtful arable and potentially arable land.

The use of the helicopter was recognized as an efficient and economic method of doing soil survey work. The cost per square mile amounted to \$0.80 compared with \$1.81 for the pack-horse method.

Table 2.- List prices of some of the most popular aircraft, as reported by the Interstate Aircredit Corporation, Minneapolis, Minnesota, in 1957 a/

<u>Aeronca</u>			<u>Piper</u>		
1946-47	"65" Champ	\$1,060	1946	J-3	\$1,361
1946-47	"65" Chief	1,166	1948-49	PA11-65	1,754
1948	Sedan	3,288	1948-49	PA11-90	2,397
1950	Champ 7EC-90	2,236	1950	PA18-115	2,875
			1953	PA20	4,617
			1953	PA18-135	3,985
			1956	PA18-150	6,456
			1946	PA12	1,944
			1950	PA20	3,435
			1951	PA22	3,902
			1956	PA22	7,376
			1957	PA18-A"150"	7,608
<u>Cessna</u>					
1946-47	"120"	\$2,323			
1946	"140"	2,629			
1948	"170"	4,238			
1951	"170A"	4,768			
1952	"170B"	5,772			
1956	"170B"	7,686			
<u>Mooney</u>			<u>Taylorcraft</u>		
1949-51	Mite	\$1,897	1946		\$1,004
1954	Mite	2,647			
<u>Stinson</u>			<u>Luscombe</u>		
1946-47	"150"	\$2,844	1947	8E "85"	\$2,130
1947-58	"165"	3,218	1948-49	8F	2,774

a/ The prices include the ten per cent sales tax and an estimated ten per cent for transportation to Canada plus inspection costs.

The cost of installing the boom type spraying equipment is about \$1,000 to \$1,200 - not included in the above prices.

"All-risk, ground" insurance in the United States, which includes fire, theft and windstorm, averages \$2.75 per \$100 of insured value, depending on the geographical location. "Crash" insurance averages \$15.00 per \$100 of insured value, depending on the area of operation, the experience of pilots and whether or not a "named pilot" form can be used. Crash coverage can be arranged for short term policies.

The helicopter, however, is a very costly piece of machinery and most farmers could not afford one. The smaller types cost from \$40,000

to \$50,000 and the larger commercial and military types about \$280,000. The helicopter is not an economic match for the conventional fixed-wing type of aircraft, especially the very efficient light plane (Table 2). It may, of course, be used in future for special types of spraying or dusting by commercial operators.

For commercial transportation of agricultural produce the larger types of helicopters would have to be used to make efficient use of a payload. However, the rates vary from \$230 to \$480 per hour and are probably too high to justify the use of the helicopter for this type of transportation.

AERIAL PHOTOGRAPHY AND AGRICULTURE

All of Canada's 3,845,774 square miles of land area have been covered by aerial photographs of all types and scales. Aerial photographic coverage began with the experimental years 1920 to 1922. From 1920 to 1943 inclusive, 904,525 square miles were covered and from 1944 to 1957 inclusive, 3,987,064 square miles were covered by federal aerial photographs. The largest annual coverages were made in 1948, 1949 and 1950 when 800,000, 871,000 and 825,000 square miles, respectively, were photographed.

All the farming areas of Canada have been covered by aerial photographs, mostly at the efficient scale of 1,320 feet to the inch. The Canada Department of Agriculture has used all types of aerial photographs extensively. The Soil Survey experts of the Field Husbandry Division of the Experimental Farms Service, the Prairie Farm Rehabilitation Administration and the Economics Division have libraries containing photographs covering 259,776, 249,500 and 162,396 square miles, respectively, across Canada. Some of the provinces carry out aerial photographic programs of their own and the agricultural departments of these provinces use these sources of aerial photographs in their own work. However, all provincial agricultural departments use the Federal air photo coverage.

The aerial photographs have been used in agriculture for soil surveys, damsite investigations, watershed and irrigation studies, community pasture layout, granular investigations, land classification, land-use and change in land-use studies, land form identifications, and crop identifications.

FORESTRY SPRAYING

Although the study was originally intended simply to find the extent of the use of the aircraft in agriculture, some enquiries were made to secure information on forestry spraying in Canada.

The approximate forestry acreage sprayed in Canada, in 1957, was as follows:

New Brunswick	--	5.2 million acres for the control of the spruce budworm;
Gaspe, Quebec	--	1.25 million acres for the control of the spruce budworm;
Ontario	--	6,000 acres for the control of hardwoods covering young conifers; 4,000 acres in southern Ontario for the control of the spruce budworm;
British Columbia	--	150,000 acres for the control of the black-headed budworm in mixed hemlock and amabilis fir.

In the New Brunswick and Quebec areas about 190 aircraft were employed; however, these were mostly hired from United States firms because of the lack of such aircraft in Canada, and for the sake of expediency. Moreover spraying aircraft are idle during many months each year and an operator would thus be ill-advised to make such an investment.

FUTURE STUDIES

There is no doubt that experiments on the economic differences between ground and air types of spraying or differences between air-spraying and non-spraying would yield valuable information to the individual farmer and to the commercial and private aircraft operators. Fields to be sprayed by aircraft, fields to be sprayed by ground methods and non-sprayed fields could be surveyed in local areas.

AGRICULTURAL SPRAYING AND DUSTING IN OTHER COUNTRIES

Australia.-- During the year ended June 30, 1956 from 70 to 80 aircraft participated in agricultural work.

The work included the fertilizing of 430,981 acres, the combined fertilizing and seeding of 77,036 acres, the seeding of 19,260 acres and the spraying of 547,956 acres for weed and insect control.

New Zealand.-- During the year ended March 1956, 59 aerial companies operated 272 aircraft for agricultural purposes.

The flying consisted mostly of fertilizing 4,000,000 acres of land and the dropping of fencing posts, battens and fencing wire over large hilly pastoral areas.

United States. - There were 5,070 aircraft used for agricultural purposes, 4,510 aircraft for spraying or dusting and 560 for other agricultural purposes in 1956.

All agricultural activities covered 51,938,000 acres including 38,667,000 acres for insect control, 5,641,000 acres for weed control, 1,098,000 acres for the control of plant disease, 568,000 acres for brush control, 2,393,000 acres fertilized, 1,976,000 acres for defoliation, and 1,595,000 acres for seeding.

PUBLICATIONS ON SPRAYING AND DUSTING

The following list of publications relate to the use of aircraft for agricultural purposes:

The Use of the Aircraft in Agriculture in the U.S.A. - published by the Organization for European Economic Co-operation, Paris, in November 1953. (Development of agricultural aviation in the United States - the future of agricultural aviation in Europe - the use of aircraft in agriculture - research and extension work on agricultural aviation - economic aspects of the use of aircraft in agriculture - operational costs - field operations - equipment - economic data - operational data - technical requirements of fixed-wing agricultural aircraft - technical description of application equipment).

How to Spray the Aircraft Way - published by the United States Department of Agriculture (Farmers' Bulletin No. 2062), June 1954. (A fine guide for farmers and spray-plane pilots - information on aerial versus ground spraying - spraying versus dusting - spraying equipment and personnel - safety pointers for the spray-plane pilot - flying procedures - legal aspects - charts for calculating chemical mixtures).

Studies of Airplane Spray - Despoit Patterns at Low Flight Levels - published by the United States Department of Agriculture (Technical bulletin No. 1110), May 1955. (Evolution of the spray curtain - gross swath widths - effective swath in preliminary studies with DDT and oil - effect of boom position - patterns from a tail boom - patterns from variations in nozzle placement - patterns from different types of nozzles - combinations of "fine-spray" and "large-droplet" - farming nozzles - effect of skid fin - effect of squared wing-tips - effect of skid plates on spray patterns).

Growth of the Agricultural Aviation Industry in New Zealand - In the New Zealand Journal of Agriculture, August 1957, p.165, published by the New Zealand Department of Agriculture. (Restoring fertility and protective cover on pastoral lands by aerial spraying and seeding - the development of packaging, flying and dropping techniques for aerial delivery of fencing materials - 1.75 million tons of fertilizer distributed on the equivalent of 12 million acres of hilly country have contributed to the 20 per cent increase in sheep and cattle numbers).